PB-240 501

CANNONSVILLE RESERVOIR, DELAWARE COUNTY, NEW YORK

Pacific Northwest Environmental Research Laboratory

Prepared for:

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New York State Department of Environmental Conservation
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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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I

REPORT
ON
CANNONSVILLE RESERVOIR
DELAWARE COUNTY
NEW YORK

EPA REGION II

WORKING PAPER No. 150

WITH THE COOPERATION OF THE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

AND THE

NEW YORK NATIONAL GUARD

DECEMBER, 1974

11

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the New York Department of Environmental Conservation for professional involvement and to the New York National Guard for conducting the tributary sampling phase of the Survey.

Henry L. Diamond, Commissioner of the New York Department of Environmental Conservation, and Leo J. Hetling, Director, and Italo G. Carcich, Senior Sanitary Engineer, Environmental Quality Research, Department of Environmental Conservation, provided invaluable lake documentation and counsel during the Survey.

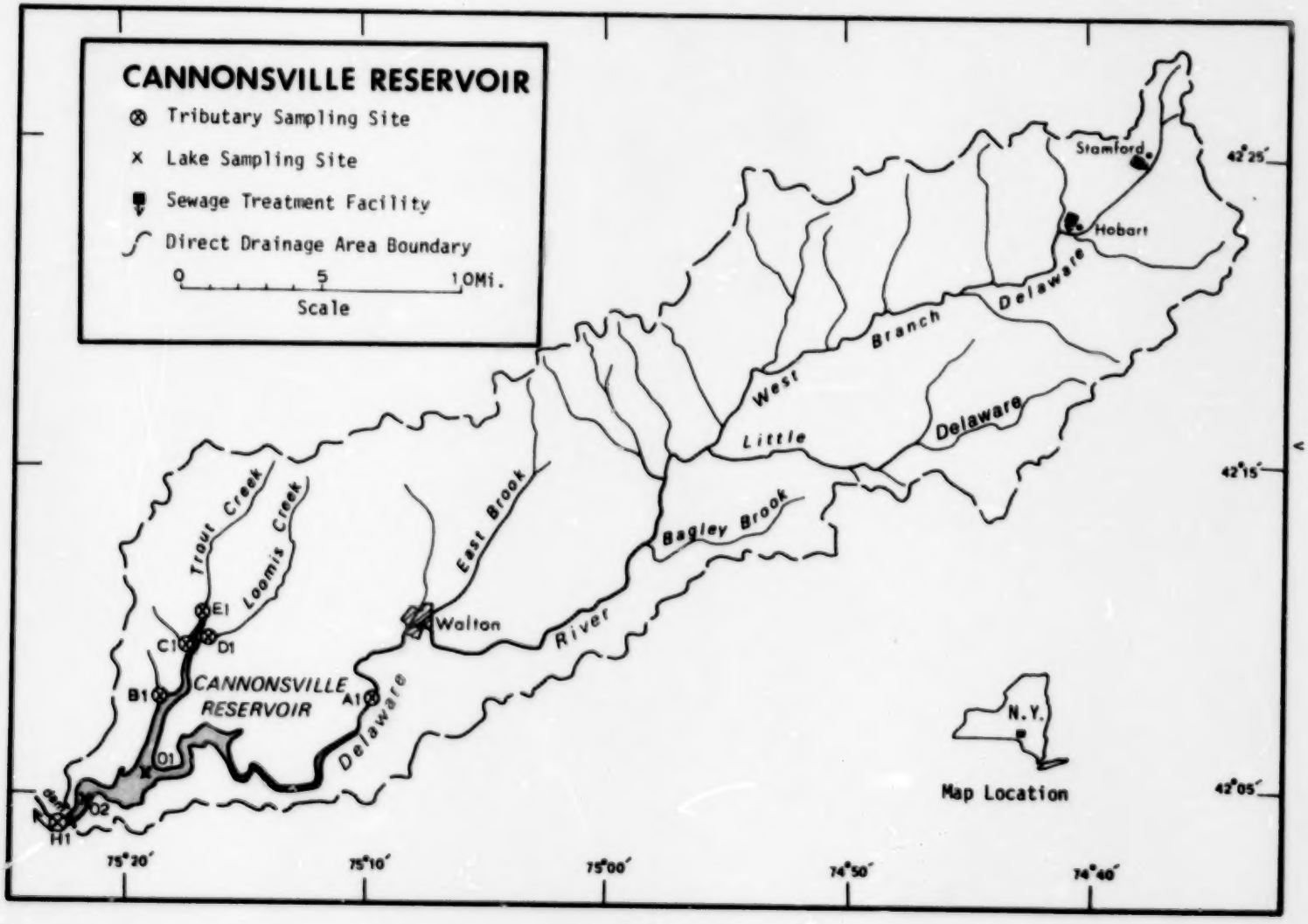
Major General John C. Baker, the Adjutant General of New York, and Project Officer Lieutenant Colonel Fred Peters, who directed the volunteer efforts of the New York National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW YORK

LAKE NAME	COUNTY
Allegheny Reservoir	Cattaraugas, NY; McLean, Warren, PA
Black	St. Lawrence
Canadaigua	Ontario
Cannonsville	Delaware
Carry Falls	St. Lawrence
Cassadaga	Chautauqua
Cayuga	Seneca, Tompkins
Champlain	Clinton, Essex, NY; Addison, Chittenden, Franklin, VT
Chautauqua	Chautauqua
Conesus	Livingston
Cross	Cayuga, Onondaga
Goodyear	Otsego
Huntington	Sullivan
Keuka	Ontario
Long	Hamilton
Lower St. Regis	Franklin
Otter	Cayuga
Owasco	Cayuga
Raquette Pond	Franklin
Round	Saratoga
Sacandaga Res.	Fulton, Saratoga
Saratoga	Saratoga
Schroon	Essex, Warren
Seneca	Seneca, Schyler, Yates
Swan	Sullivan
Swinging Bridge Res.	Sullivan


CANNONSVILLE RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Direct Drainage Area Boundary
0 5 10Mi.
Scale
Stamford
Hobart
42°25'
West Branch Delaware
Little Delaware
42°15'
Trout Creek
Loomis Creek
East Brook
Bagley Brook
E1
C1
D1
Walton
River
B1
CANNONSVILLE RESERVOIR
A1
Delaware
O1
O2
H1
N.Y.
Map Location
42°05'
75°20'
75°10'
75°00'
74°50'
74°40'

CANNONSVILLE RESERVOIR

STORET NO. 3605

I. CONCLUSIONS

A. Trophic Condition:

Although only limited Survey data are available to assess the trophic condition of Cannonsville Reservoir, all evidence indicates that Cannonsville Reservoir is now eutrophic and is undergoing further eutrophication at an accelerated rate.

B. Rate-Limiting Nutrient:

No algal assay was performed on the waters of Cannonsville Reservoir; however, nitrogen to phosphorus ratios in the reservoir in May (24 to 1) and in tributaries unaffected by point waste sources, indicate that primary production in Cannonsville Reservoir should be phosphorus limited. This conclusion is reinforced by the fact that the majority of other surveyed lakes in the northeast are phosphorus limited or would become phosphorus limited if point-source phosphorus were controlled.

C. Nutrient Controllability:

Adequate data are available to assess inputs of phosphorus and nitrogen to Cannonsville Reservoir during the sampling year. These data indicated that the point-source total phosphorus input to the reservoir was about seven times greater than the amount attributable to non-point sources. The excessive phosphorus load was input to the reservoir by the West Branch,

Delaware River at the rate of about 176,600 pounds of total phosphorus annually. On the basis of other tributary loads to the reservoir, approximately 20,000 lbs P/year can be attributed to non-point source runoff while 156,600 lbs P/year in the West Branch, Delaware River can be attributed to either industrial or municipal point source contributions. Breakstone Foods (at Walton, NY) was identified as a major phosphorus contributor to the West Branch, Delaware River. The Village of Walton also is believed to contribute significantly. Two other dairy-related industries located in the West Branch, Delaware River drainage, which are potentially large phosphorus contributors, are Deltown Foods, Inc. and the Dairy Lea Cooperative, both near Delhi, New York. Both industries, particularly Deltown Foods, need further investigation to determine effluent nutrient loads.

If a high degree of point source phosphorus reduction were implemented in the West Branch, Delaware River drainage to Cannonsville Reservoir, phosphorus loadings to the reservoir could be reduced from the present 4.26 grams P/m^2/year to 0.61 grams P/m^2/year; i.e., a mesotrophic loading rate (see pages 16 and 17).

II. INTRODUCTION

Cannonsville Reservoir was included among the New York lakes and reservoirs studied by the National Eutrophication Survey. Initially Cannonsville Reservoir was to be sampled three times between May and November, 1972; however, after the first sampling, the EPA field staff, which conducted waste sampling from pontoon-equipped helicopters, were informed that they were prohibited from landing on Cannonsville because it was used as a source of water supply for New York City. Consequently, only one set of lake samples was obtained in May, 1972, and the algal assay study was not performed.

Seven tributaries and the outlet of Cannonsville Reservoir (Delaware River) were sampled monthly by the New York National Guard from November, 1972, through October, 1973. These samples were preserved with mercuric chloride and shipped to the EPA Pacific Northwest Environmental Research Laboratory where they were analyzed for phosphorus and nitrogen.

The stream flow estimates used in the report were provided by the New York District Office of the U.S. Geological Survey through an inter-agency agreement.

Very little background data was available on Cannonsville Reservoir at the time of preparation of this report. Personnel of the EPA Water Supply Branch, Region II (MacLemon, 1974), indicated that Cannonsville Reservoir was filled by 1965, and that New York City uses the reservoir

to a very limited extent for water supply purposes primarily due to the poor quality of the water. It was also indicated that algal problems occur in the reservoir during the summer months, and "huge pulses" of algae have been observed by others (Schumacher and Wager, 1973).

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 4,800 acres.
2. Mean depth: 63 feet.
3. Maximum depth: unknown.
4. Volume: 302,600 acre/ft.
5. Mean hydraulic retention time: 210 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
West Branch, Delaware River	351.0 mi^2	570.0 cfs
Dry Brook	4.4 mi^2	6.0 cfs
Sherruck Brook	5.5 mi^2	8.0 cfs
Loomis Brook	12.4 mi^2	18.0 cfs
Trout Creek	22.6 mi^2	37.0 cfs
Maxwell Brook	1.3 mi^2	2.0 cfs
Dryden Brook	10.0 mi^2	16.0 cfs
Minor tributaries & immediate drainage -	39.3 mi^2	69.0 cfs
Totals	446.5 mi^2	726.0 cfs

2. Outlet -

Delaware River	454.0 mi^2**	726.0 cfs***

C. Precipitation****:

1. Year of Sampling: 60.3 inches.
2. Mean annual: 48.3 inches.

† Greeson and Robison, 1970.
* Drainage areas are accurate within ±5%, except for small basins (±10%); mean daily flows are accurate within ±5 to 25%; and normalized mean monthly flows are accurate within ±15%.
** Includes area of lake.
*** Includes withdrawal by New York City and assumes that outflow equals inflow.
**** See Working Paper No. 1, "Survey Methods".

IV. LAKE WATER QUALITY SUMMARY

Cannonsville Reservoir was sampled only once in May, 1972, before the Survey field crews were prohibited further access to the reservoir by the Federal Aeronautics Authority (FAA). All lake sampling was done by helicopter, and the FAA apparently does not permit landings on lakes used for water supply purposes. In any event, two stations were sampled during the single visit to the lake. The station locations are indicated on the map (page v).

The maximum depths sampled were 54 feet at station 1 and 53 feet at station 2.

The results of the lake sampling are presented in Appendix B and are summarized below. The mean values presented in the summary tables are not volume-weighted; nevertheless, the means serve as a general guide to water quality in the lake.

A. Physical and chemical characteristics:

Parameter	Min. value of 5/21/72 samples	Max. value of 5/21/72 samples	Mean value of 5/21/72 samples
Temperature (Cent.)	5.1	18.4	12.3
Dissolved oxygen (mg/l)	8.8	11.5	10.0
Conductivity (μmhos)	50	70	63
pH (units)	6.1	9.2	7.4
Alkalinity (mg/l)	10	10	10
Total P (mg/l)	0.029	0.098	0.055
Dissolved P (mg/l)	0.015	0.039	0.025
NO_2 + NO_3 (mg/l)	0.310	0.730	0.497
Ammonia (mg/l)	0.050	0.250	0.108
Chlorophyll a (μg/l)	27.8	32.0	29.9
Secchi disc (inches)	72	72	72

B. Biological characteristic:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
05/21/72	1. Dinobryon	3,526
	2. Cyclotella	1,465
	3. Chlamydomonas	380
	4. Asterionella	199
	5. Cryptomonas	163
	Other genera	108
	Total	5,841

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
5/21/72	01	32.0
	02	27.8

C. Limiting Nutrient:

Ordinarily an algal assay analysis is performed on each lake included in the National Eutrophication Survey; however, for 1972 lakes the algal assay samples were collected during the third round of sampling. Because Cannonsville Reservoir was only sampled once, the algal assay sample was not collected.

Even though an algal assay was not performed, some judgements can be made concerning limiting nutrients. Cannonsville Reservoir is located in an area in which lakes primarily are phosphorus

limited. Algal assays have been done on samples from approximately 200 Survey lakes, and it has been found that lake waters are phosphorus limited when the nitrogen to phosphorus ratio is greater than 14 to 1. The ratio of nitrogen load to phosphorus load in all six of the unimpacted streams entering Cannonsville, was approximately 46 to 1, and the mean ratio in the reservoir in May, 1972, was 24 to 1. This indicates that primary productivity in Cannonsville Reservoir should be limited by phosphorus.

D. Trophic Condition:

Though the data from Cannonsville Reservoir were very limited, there are strong indications that the reservoir is eutrophic. Total and dissolved phosphorus concentrations in the reservoir were high as were chlorophyll a concentrations. Only 4 of the 26 New York lakes sampled three times had higher mean total phosphorus concentrations and only one had higher mean chlorophyll a concentrations.

The phosphorus loading data which are presented later in this report are also indicative of eutrophic conditions.

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the New York National Guard collected a monthly near-surface grab sample from each of the tributary sites indicated on the map (page v), except for the high runoff months of April and May when two samples were collected. Sampling was begun in November, 1972, and was completed in October, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New York District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the nutrient loads, in lbs/mi^2/year, of the unimpacted streams sampled in the drainage and multiplying the means by the ZZ area in mi^2.

A. Nutrients from point sources:

All of the municipal and industrial waste sources listed below discharge to the West Branch of the Delaware River. As far as is known, these are the only significant waste discharges

* See Working Paper No. 1.

in the Cannonsville drainage area; however, an exhaustive search was not made. None of the listed point sources were sampled during the survey; however, data were obtained from personnel of the EPA Region II Office (Bricke, 1974) for the Village of Walton and Breakstone Foods, Inc. in Walton, New York. These data originated in an October, 1973, report entitled, "Environmental Assessment Statement for the Village of Walton", that was prepared by the engineering firm of Quirk, Lawler, and Matusky (1973). The Region II Office also furnished the information on two other industries located in the Cannonsville drainage area; i.e., Deltown Foods, Inc., and Dairy Lea Cooperative, Inc. The data for these industries were derived from company applications for permits to discharge wastes.

Other than the listed point sources, all discharging to the West Branch, Delaware River, no point sources are known elsewhere in the Cannonsville Reservoir watershed.

The table below lists the known municipal and industrial waste sources to the West Branch, Delaware River.

POINT SOURCE WASTES DISCHARGED TO THE WEST BRANCH, DELAWARE RIVER

Name (Population or Product)	Treatment Type	Mean Effluent Flow (mgd)	lbs Total P/yr Discharged	lbs Total N/yr Discharged	Approximate Distance from Reservoir
Municipal					
Walton (3,744)	Septic tanks	?	6,200	26,280	5 miles
Hobart (531)	Sand filter	0.053	1,330	3,980	37 miles
Stamford (1,286)	Prim. clarifier	0.129	3,210	9,640	41 miles
Industrial					
Breakstone Foods (Cottage cheese)	None	0.632	70,080	16,060	5 miles
Deltown Foods, Inc. (Dairy products)	?	0.502	440	2,730	22 miles
Dairy Lea Cooperative (Dairy products)	?	?	120	60	22 miles

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/sq mi drainage/yr	Total lbs P/yr	% of total
a. Tributaries - (including point sources)			
West Branch, Delaware	503	176,560	96.7
Dry Brook	48	210	0.1
Sherruck Brook	75	410	0.2
Loomis Brook	52	650	0.4
Trout Creek	59	1,340	0.7
Maxwell Brook	45	60	0.1
Dryden Brook	43	430	0.2
b. Minor tributaries & immediate drainage -	54	2,120	1.2
c. Direct precipitation* -	-	750	0.4
Total	-	182,530	100.0

2. Outputs -

Lake outlet**	53,400

3. Net annual P accumulation - 129,130

* See Working Paper No. 1.
** Assumes that any water withdrawn by New York City has same phosphorus content as the reservoir discharge to the Delaware River.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/sq mi drainage/yr	Total lbs N/yr	% of total
a. Tributaries - (including point sources)			
West Branch, Delaware	4,550	1,597,470	85.0
Dry Brook	1,405	6,180	0.3
Sherruck Brook	1,604	8,820	0.5
Loomis Brook	2,660	32,990	1.8
Trout Creek	2,990	67,480	3.6
Maxwell Brook	2,560	3,330	0.2
Dryden Brook	2,473	24,730	1.3
b. Minor tributaries & immediate draingae -	2,282	89,680	4.8
c. Direct precipitation* -	-	46,240	2.5
Total	-	1,876,920	100.0

2. Outputs -

Lake outlet** 1,435,430

3. Net annual N accumulation - 441,490 lbs

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* See Working Paper No. 1.
** Assumes that any water withdrawn by New York City has same nitrogen content as the reservoir discharge to the Delaware River.

D. Discussion of Nutrient Loading:

The previous two tables indicate that 96.7% of the total phosphorus and 85% of the total nitrogen load to Cannonsville Reservoir originates from the West Branch of the Delaware River. The data also indicate that the phosphorus load exported annually from the West Branch, Delaware River, on a unit-area basis, is nearly 10 times greater than the average load contributed by the other tributaries to Cannonsville Reservoir; i.e., 503 lbs total P/sq mi/year from the Delaware versus an average of 57 lbs total P/sq mi/year from the other six tributary streams.

To a lesser extent, the same is true of nitrogen. The Delaware drainage contributes approximately 4,550 lbs total N/sq mi/year while the average of the six other drainage areas is 2,282 lbs total N/sq mi/year.

Differences in land use cannot account for the tremendous differences in phosphorus export between the West Branch, Delaware drainage and the other tributary systems. The West Branch, Delaware drainage is approximately 67% forested and 27% cropland while the other drainage areas range from 66-93% forested and 3-19% cropland. Therefore, one would expect approximately the same loadings on a unit-area basis.

The excessive phosphorus load to Cannonsville Reservoir can only be attributed to industrial and domestic point sources in

the West Branch, Delaware drainage area. The largest known industrial contributor is Breakstone Foods located at Walton, a short distance upstream from the reservoir. The Breakstone wastes account for 70,080 lbs total phosphorus/year according to the best information available. The Village of Walton accounts for an additional 6,200 lbs total phosphorus/year.

The other two known municipal waste discharges in the West Branch Delaware, Stamford and Hobart, are probably insignificant contributors because they are relatively small towns located approximately 40 miles from the reservoir.

The other two industrial discharges in the West Branch, Delaware drainage--Deltown Foods, Inc., and Dairy Lea Cooperative--are worthy of further investigation. Both are potentially heavy contributors of nutrients, yet available information does not indicate significant contributions.

The domestic and industrial discharges mentioned above account for a large part of the excessive phosphorus load entering Cannonsville Reservoir, but not the entire load. A more intensive investigation of point-source loadings in the West Branch, Delaware River is needed to fully evaluate the high phosphorus and nitrogen loadings.

If point source phosphorus contributions to the West Branch, Delaware River were greatly reduced or eliminated, Cannonsville

Reservoir has the potential of having very good water quality. The existing phosphorus load to Cannonsville Reservoir from all sources is 182,520 pounds/year of which 176,560 lbs P/year originates from the West Branch, Delaware River. If point-source phosphorus contributions were eliminated, one would assume that the Delaware drainage would export approximately the same quantity of phosphorus as the average of the other tributaries to the reservoir; i.e., 57 lbs P/sq mi/year. Under that condition, the total phosphorus load to the reservoir from all sources would be only 26,970 lbs P/year of which 20,000 lbs P/year would originate from the West Branch, Delaware River.

In 1968, Vollenweider developed a relationship between phosphorus and nitrogen loading rates to lakes, lake morphometry and lake trophic condition which he modified in 1973 (in press). It is interesting and informative to compare the Cannonsville Reservoir phosphorus data to the loading levels which Vollenweider indicates would be expected to result in a eutrophic and mesotrophic condition for the reservoir. This comparison is made in the following table.

Existing Total Phosphorus Loading Rate to Cannonsville Reservoir Compared to Achievable Loading Rate with Point-Source Phosphorus Control.

	Existing Total Phosphorus Loading to Cannonsville Reservoir	Achievable Total Phosphorus Loading to Cannonsville with Point Source Controls
grams P/meter^2/year	4.26	0.61

Vollenweider theoretical loading rates for total phosphorus (grams/m^2/yr) based on mean depth and mean detention time of Cannonsville Reservoir:

"Dangerous" (eutrophic rate)	1.05
"Permissible" (oligotrophic rate)	0.55

According to Vollenweider, a phosphorus limited water body with the morphometry of Cannonsville would be expected to remain eutrophic if the annual surface loading exceeded the "Dangerous" level (1.05 g/m^2/year). If the loading rate was less than the "Dangerous" level but greater than the "Permissible" loading (0.55 g/m^2/year), Cannonsville Reservoir would be expected to become mesotrophic.

The relationship cited above points out that current phosphorus loadings to Cannonsville Reservoir are much too high and that a reduction of the loadings to natural or background levels (without point source influence) should markedly decrease the eutrophication rate of Cannonsville Reservoir.

VI. LITERATURE REVIEWED

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VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW YORK 11/26/74

LAKE CODE 3605 CANNONSVILLE RESERVOIR

TOTAL DRAINAGE AREA OF LAKE 454.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3605A1	351.00	653.00	695.00	1140.00	1460.00	589.00	297.00	159.00	153.00	194.00	243.00	575.00	703.00	570.08
3605P1	4.39	7.14	8.00	14.20	17.90	6.36	3.53	1.00	1.10	2.09	3.10	6.24	7.48	6.49
3605C1	5.47	8.90	9.97	17.70	22.40	7.93	4.40	1.26	1.37	2.60	3.86	7.77	9.33	8.10
3605D1	12.40	20.20	22.60	40.20	50.70	18.00	9.97	2.85	3.11	5.90	8.76	17.60	21.20	18.36
3605E1	22.60	36.90	41.30	73.50	92.60	32.90	18.20	52.10	5.69	10.80	16.00	32.20	38.60	37.53
3605F1	1.29	2.07	2.25	4.23	5.66	2.26	1.05	3.50	0.50	0.62	0.91	1.81	2.25	2.26
3605G1	10.10	16.20	17.60	33.10	44.20	17.70	8.21	2.74	3.91	4.86	7.10	14.10	17.60	15.57
3605H1	454.00	115.00	171.00	413.00	975.00	680.00	577.00	784.00	604.00	657.00	4.29	118.00	186.00	441.02
3605Z7	46.75	76.00	85.20	152.00	191.00	67.80	37.60	10.70	11.70	22.20	33.00	66.40	79.70	69.20

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 454.00
SUM OF SUB-DRAINAGE AREAS = 454.00

TOTAL FLOW IN = 8756.11
TOTAL FLOW OUT = 5284.29

NOTE *** OUTLET (TRIB H1) DOES NOT INCLUDE WITHDRAWAL BY NEW YORK CITY

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3605A1	11	72	1430.00	5	737.00				
	12	72	1580.00	2	1160.00				
	1	73	867.00	6	848.00				
	2	73	564.00	3	3120.00				
	3	73	897.00	3	400.00				
	4	73	1280.00	7	2230.00	21	622.00		
	5	73	1390.00	5	512.00	19	3780.00		
	6	73	1020.00	2	603.00				
	7	73	485.00	7	548.00				
	8	73	113.00	4	184.00				
	9	73	67.40	7	67.00				
	10	73	44.00	13	46.60				
3605B1	11	72	25.60	5	7.40				
	12	72	17.50	2	9.90				
	1	73	9.78	6	8.60				
	2	73	5.93	3	12.00				
	3	73	10.60	3	4.80				
	4	73	15.10	7	24.00	21	4.40		
	5	73	15.70	5	3.36	19	44.80		
	6	73	14.60	2	14.10				
	7	73	6.40	7	7.20				
	8	73	3.43	4	4.18				
	9	73	2.66	7	1.76				
	10	73	2.14	13	1.43				

TRIBUTARY FLOW INFORMATION FOR NEW YORK 11/26/74

LAKE CODE 3605 CANNONSVILLE RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3605C1	11	72	32.00	5	9.30				
	12	72	21.90	2	12.30				
	1	73	12.20	6	10.70				
	2	73	7.40	3	14.20				
	3	73	17.30	3	7.80				
	4	73	24.60	7	38.00	21	7.10		
	5	73	25.70	5	6.50	19	86.80		
	6	73	10.00	2	9.68				
	7	73	4.40	7	4.95				
	8	73	1.72	4	2.09				
	9	73	1.33	7	0.88				
	10	73	1.08	13	0.71				
3605D1	11	72	72.60	5	21.00				
	12	72	49.80	2	28.00				
	1	73	27.70	6	24.00				
	2	73	16.80	3	32.00				
	3	73	36.30	3	16.00				
	4	73	51.60	7	124.00	21	15.00		
	5	73	53.80	5	14.00	19	182.00		
	6	73	24.70	2	23.80				
	7	73	14.00	7	15.80				
	8	73	8.89	4	10.80				
	9	73	6.90						
	10	73	5.60	13	3.70				
3605F1	11	72	128.00	5	37.00				
	12	72	87.70	2	49.00				
	1	73	56.30	6	44.00				
	2	73	30.60	3	58.00				
	3	73	61.90	3	27.80				
	4	73	88.10	7	138.00	21	25.50		
	5	73	91.90	5	23.30	19	311.00		
	6	73	71.20	2	32.00				
	7	73	16.00	7	9.40				
	8	73	8.74	4	10.60				
	9	73	5.81	7	3.84				
	10	73	4.72	13	3.12				
3605F1	11	72	7.14	5	2.10				
	12	72	4.90	2	2.80				
	1	73	2.87	6	2.50				
	2	73	1.74	3	3.40				
	3	73	2.79	3	1.30				
	4	73	3.97	7	6.20	21	1.20		
	5	73	4.14	5	1.10	19	14.00		
	6	73	1.83	2	1.76				
	7	73	0.80	7	0.90				
	8	73	0.16	4	0.19				
	9	73	0.12	7	0.08				
	10	73	0.10	13	0.06				

TRIBUTARY FLOW INFORMATION FOR NEW YORK 11/26/74

LAKE CODE 3605 CANNONSVILLE RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3605G1	11	72	57.10	5	17.00				
	12	72	39.20	2	22.00				
	1	73	22.50	6	20.00				
	2	73	13.70	3	26.00				
	3	73	28.00	3	20.00				
	4	73	40.00	7	78.00	21	15.00		
	5	73	41.00	5	12.00	19	165.00		
	6	73	14.50	2	14.10				
	7	73	8.00	7	4.00				
	8	73	4.21	4	5.13				
	9	73	3.27	7	2.16				
	10	73	2.65	13	1.76				
3605H1	11	72	58.70	5	42.00				
	12	72	451.00	2	15.00				
	1	73	1231.00	6	2040.00				
	2	73	852.00	3	1900.00				
	3	73	1260.00	3	543.00				
	4	73	1690.00	7	3620.00	21	951.00		
	5	73	1520.00	5	665.00	19	3660.00		
	6	73	943.00	2	934.00				
	7	73	988.00	7	1190.00				
	8	73	156.00	4	61.00				
	9	73	786.00	7	1150.00				
	10	73	787.00	13	1060.00				
3605ZZ	11	72	225.00						
	12	72	211.00						
	1	73	117.00						
	2	73	121.00						
	3	73	130.00						
	4	73	170.00						
	5	73	190.00						
	6	73	64.30	2	62.00				
	7	73	28.20	7	31.70				
	8	73	11.00	4	13.40				
	9	73	8.52	7	5.63				
	10	73	6.92	13	4.58				

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APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/11/26

360501
42 05 30.0 075 19 30.0
CANNONSVILLE RESERVOIR
36 NEW YORK

11EPALES
4

2111202
0110 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/05/21	17 15	0000	17.7	8.8	72	70	8.90	10	0.380	0.070	0.029	0.015
	17 15	0010	13.8	9.5		50	7.50	10	0.430	0.100	0.049	0.017
	17 15	0054	5.1	9.0		60	6.10	10	0.730	0.100	0.044	0.039

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/05/21	17 15	0000	32.0J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/11/26

360502
42 04 30.0 075 22 00.0
CANNONSVILLE RESERVOIR
36 NEW YORK

11EPALES
4

2111202
0125 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/05/21	17 45	0000	18.4	11.5	72	60	9.20	10K	0.310	0.050	0.068	0.016
	17 45	0010	13.3	10.6		70	6.30	10	0.440	0.250	0.098	0.027
	17 45	0053	5.5	10.4		70	6.30	10	0.690	0.080	0.041	0.037

25

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/05/21	17 45	0000	27.8J

K VALUE KNOWN TO BE LESS THAN INDICATED

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/11/26

3605A1 LS3605A1
42 07 30.0 075 09 30.0
W BR DELAWARE RIVER
36 7.5 WALTON WEST
I/CANONSVILLE RESERVOIR
ST HWY 10 2.5 MI SW OF WALTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	12 30		0.900	0.400	0.046	0.048	0.096
72/12/02	16 20		0.230	0.100K	0.013	0.029	0.044
73/01/06	13 00		0.940	0.260	0.019	0.020	0.035
73/02/03	13 20		0.180	0.770	0.066	0.018	0.260
73/03/03	13 30		1.020	1.760	0.097	0.078	0.165
73/04/07	10 25		0.740	0.240	0.019	0.026	0.055
73/04/21	13 30		0.710	0.625	0.031	0.044	0.085
73/05/05	10 23		0.590	0.230	0.005K	0.071	0.100
73/05/19	13 30		0.420	0.790	0.023	0.028	0.070
73/06/02	12 45		0.440	1.000	0.060	0.030	0.065
73/07/07	10 30		1.000	1.900	0.110	0.046	0.075
73/08/04	12 05		0.700	0.690	0.018	0.190	0.260
73/09/07	13 15		0.032	1.100	0.028	0.450	0.580
73/10/13	10 30		0.640	1.680	0.680	0.280	0.345

K VALUE KNOWN TO BE
LESS THAN INDICATED

27

STORET RETRIEVAL DATE 74/11/26

360581 LS360581
42 08 00.0 075 18 30.0
DRY BROOK
36 7.5 TROUT CREEK
T/CANNONSVILLE RESERVOIR
AT DRY BROOK RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	10 30		0.182	0.100K	0.042	0.009	0.014
72/12/02	15 10		0.054	0.100K	0.005K	0.006	0.011
73/01/06	12 00		0.068	0.180	0.020	0.005K	0.010
73/02/03	12 20		0.740	0.130	0.130	0.006	0.010
73/03/03	12 40		0.220	0.310	0.040	0.014	0.020
73/04/07	11 20		0.084	0.180	0.056	0.014	0.030
73/04/21	12 35		0.032	0.100K	0.017	0.005K	0.010
73/05/05	11 20		0.032	0.100K	0.005K	0.012	0.012
73/05/19	12 35		0.063	1.540	0.048	0.008	0.022
73/06/02	11 15		0.023	0.580	0.026	0.008	0.015
73/07/07	11 25		0.050	0.100K	0.019	0.014	0.015
73/08/04	12 05		0.147	0.100K	0.006	0.012	0.015
73/09/07	14 45		0.048	0.440	0.012	0.007	0.030
73/10/13	11 05		0.040	1.150	0.330	0.011	0.011

K VALUE KNOWN TO BE
LESS THAN INDICATED

28

STORET RETRIEVAL DATE 74/11/26

3605C1 LS3605C1
42 09 30.0 075 17 30.0
SHERRUCK BROOK
36 7.5 TROUT CREEK
T/CANNONSVILLE RESERVOIR
MED DUTY RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	10 45		0.133	0.450	0.054	0.008	0.050
72/12/02	15 20		0.054	0.100K	0.005K	0.005K	0.011
73/01/06	12 10		0.056	0.110	0.012	0.005K	0.010
73/02/03	12 35		0.730	0.440	0.100	0.016	0.025
73/03/03	12 45		0.147	0.100K	0.018	0.010	0.015
73/04/07	11 30		0.079	0.780	0.069	0.014	0.070
73/04/21	11 45		0.026	0.250	0.011	0.005K	0.015
73/05/05	11 30		0.027	0.240	0.030	0.006	0.020
73/05/19	12 40		0.054	0.290	0.009	0.006	0.015
73/06/02	11 40		0.016	0.780	0.046	0.005K	0.015
73/07/07	11 30		0.040	0.680	0.024	0.014	0.030
73/08/04	12 10		0.180	0.100K	0.016	0.013	0.025
73/09/07	12 30		0.100	1.350	0.060	0.009	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

360501 LS360501
42 09 00.0 075 16 30.0
LOOMIS BROOK
36 7.5 TROUT CREEK
T/CANNONSVILLE RESERVOIR
ALONG LOOMIS BROOK RD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	11 00		0.660	0.150	0.056	0.011	0.021
72/12/02	15 30		0.390	0.390	0.024	0.009	0.015
73/01/06	12 20		0.315	0.140	0.014	0.009	0.015
73/02/03	12 40		2.020	0.240	0.046	0.006	0.020
73/03/03	12 50		0.530	0.250	0.060	0.021	0.045
73/04/07	11 35		0.320	0.100K	0.010	0.008	0.020
73/04/21	13 50		0.190	0.160	0.033	0.008	0.015
73/05/05	11 40		0.160	0.100K	0.028	0.006	0.015
73/05/19	12 45		0.198	1.050	0.028	0.009	0.025
73/06/02	11 30		0.085	0.930	0.037	0.007	0.020
73/07/07	11 35		0.280	0.790	0.032	0.013	0.015
73/08/04	12 15		0.330	0.170	0.005K	0.015	0.015
73/10/13	11 20		0.034	1.900	0.790	0.010	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

60

STORET RETRIEVAL DATE 74/11/26

3605E1 LS3605E1
42 10 30.0 075 17 00.0
TROUT CREEK
36 7.5 TROUT CREEK
T/CANNONSVILLE RESERVOIR
BULLOCK HILL RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	11 15		0.550	0.150	0.038	0.018	0.033
72/12/02	15 35		0.520	0.290	0.005K	0.008	0.014
73/01/06	12 15		0.470	0.100K	0.007	0.006	0.010
73/02/03	12 45		0.500	0.200	0.037	0.016	0.030
73/03/03	12 55		0.730	0.180	0.034	0.009	0.020
73/04/07	11 42		0.370	1.100	0.040	0.013	0.025
73/04/21	12 55		0.440	0.100K	0.022	0.005K	0.010
73/05/05	11 45		0.330	0.220	0.075	0.005K	0.015
73/05/19	12 15		0.250	0.820	0.054	0.009	0.020
73/06/02	11 35		0.231	1.320	0.048	0.005K	0.015
73/07/07	11 45		0.540	0.800	0.042	0.011	0.015
73/08/04	12 25		0.720	0.100K	0.007	0.012	0.015
73/09/07	12 40		0.480	0.360	0.023	0.006	0.020
73/10/13	11 25		0.560	4.600	3.500	0.006	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3605F1 LS3605F1
42 06 30.0 075 15 00.0
MAXWELL BROOK
36 7.5 CANNONSVILLE
T/CANNONSVILLE RESERVOIR
ORYDEN HILL AROG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	12 00		0.520	0.100K	0.028	0.005K	0.009
72/12/02	16 50		0.311	0.100K	0.016	0.005K	0.009
73/01/06	12 50		0.300	0.100K	0.006	0.005K	0.010
73/02/03	13 10		0.490	1.200	0.045	0.010	0.015
73/03/03	13 20		0.540	0.120	0.015	0.010	0.020
73/04/07	12 15		0.420	0.115	0.031	0.006	0.015
73/04/21	13 20		0.336	0.100K	0.007	0.005K	0.010
73/05/05	10 35		0.370		0.008	0.005K	0.025
73/05/19	13 10		0.315	1.680	0.050	0.008	0.030
73/06/02	12 20		0.168	0.930	0.030	0.007	0.015
73/07/07	10 55		0.105	0.100K	0.013	0.008	0.010
73/08/04	12 55		0.190	0.100K	0.006	0.010	0.015
73/09/07	13 00		0.138	0.440	0.024	0.005K	0.010
73/10/13	10 45		0.046	1.470	0.760	0.006	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3605G1 LS3605G1
42 07 00.0 075 15 00.0
DRYDEN BROOK
36 7.5 CANNONSVILLE
T/CANNONS VILLE RESERVOI
RDRYDEN RD BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	11 45		0.340	0.100K	0.044	0.006	0.013
72/12/02	15 55		0.208	0.100K	0.015	0.008	0.012
73/01/06	12 45		0.189	0.120	0.007	0.007	0.010
73/02/03	13 08		0.260	0.580	0.028	0.013	0.015
73/03/03	13 15		0.410	0.100K	0.029	0.008	0.015
73/04/07	12 13		0.189	0.110	0.019	0.006	0.020
73/04/21	13 15		0.120	0.130	0.038	0.006	0.015
73/05/05	10 40		0.120	1.680	0.048	0.007	0.015
73/05/19	13 05		0.126	2.500	0.084	0.008	0.060
73/06/02	12 19		0.056	0.400	0.016	0.011	0.015
73/07/07	10 50		0.115	1.200	0.075	0.010	0.020
73/08/04	12 50		0.220	0.100K	0.005K	0.014	0.015
73/09/07	12 55		0.190	0.210	0.010	0.007	0.010
73/10/13	10 50		0.036	1.600	0.520	0.006	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3605H1 LS3605H1
42 04 00.0 075 23 46.0
DELAWARE RIVER
36 7.5 DEPOSIT
O/CANNONSVILLE RESERVOIR
BELO XING OF RD OFF ST HWY 10
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/11/05	09	15	0.260	0.500	0.240	0.015	0.054
72/12/02	14	45	0.600	0.290	0.038	0.025	0.040
73/01/06	11	40	0.630	0.280	0.009	0.022	0.030
73/02/03	12	00	0.660	0.390	0.077	0.018	0.035
73/03/03	12	20	0.610	0.210	0.154	0.019	0.035
73/04/07	11	00	0.710	0.160	0.028	0.024	0.035
73/04/21	12	20	0.730	0.140	0.024	0.023	0.035
73/05/05	12	05	0.740	0.220	0.031	0.023	0.035
73/05/19	12	05	0.670	0.460	0.060	0.024	0.030
73/06/02	12	00	0.660	0.420	0.060	0.027	0.040
73/07/07	12	05	0.740	0.290	0.088	0.027	0.040
73/08/04	10	35	0.780	0.140	0.005K	0.026	0.032
73/09/07	12	00	0.740	0.400	0.039	0.020	0.025
73/10/13	11	45	0.720	0.650	0.400	0.013	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED